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Editor's Preface

In the spring of 1960 the Anthropology Club of the University of Oklahoma initiated the publication, Papers in Anthropology, a collection of student papers on various subjects in Anthropology. The Anthropology Club felt that many student papers, prepared for specific course assignments and often involving a great amount of research, would be both interesting and useful to persons interested in anthropology.

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PAPERS IN ANTHROPOLOGY
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THE QUESTION OF THE ORIGIN OF THE CENTRAL PLAINS COMPLEX

By

DON G. WYCKOFF

The area known as the Central Plains is that land in the middle of the United States proper which lies between parallels 42N and 36 N and between meridians 95W and 104W. This area would include all of Kansas and Nebraska plus some of eastern Colorado and northern Oklahoma.

A physical description of the area would say that it is a semi-arid plains country. This statement is fine for a brief description, but to really describe the Central Plains it is necessary to say much more. Semi-arid? Yes, the overall annual average of precipitation is somewhere around 20 inches with most of the moisture being rains which come to the area from the west and northwest during the spring and fall. The mean annual temperature range is about 55F degrees, but this is misleading as the summers often have days when the maximum temperature is around 120F degrees; the winters are not long but also have extreme temperatures (with as low as -40F degrees being recorded). The growing season is on the average of 175 days. A plains country? Yes, the Central Plains is a plains country but it contains many diverse areas. The western one-third can be typified as a slightly rolling country with very few stream courses. The ecology of the western area at the time of Indian occupation consisted of short grass, sage, yucca, and various types of cacti; trees were willows, cottonwood, hackberry, and ash - these grew in areas where water could be reached by their roots. There were some fruit-bearing plants such as mulberry, wild plum, and elderberry present in this area. The native fauna included such animals as bison, deer, antelope, prairie dogs, coyotes, jackrabbits, prairie chicken, and grouse. The middle one-third, which lies for 100 to 150 miles east of the Break of the Plains, is quite distinct. This middle section contains many high plateaus and ranges of hills which have been eroded by several large eastward flowing streams (such as the Platt, Republican, Solomon, Saline, and Smokey Hill) and the tributaries of these streams. The river valleys tend to grow wider as one moves east, and these valleys are very fertile. Ridges and round hills are quite common in this area. The flora of this middle section were mainly hardwood trees (oak, cottonwood, walnut, and elm) which grew abundantly along the various stream courses, and the grasses of this area were of a longer variety than those found in the western one-third. The fauna was still mainly bison, antelope, deer, elk, jackrabbits, raccoon, opossum, badger, prairie chicken, and grouse. The eastern one-third of the Central Plains is typified by many stream courses which tend to be in deep, broad, fertile valleys. The area has a great many rolling-hill sections which are extensively eroded due to more precipitation falling in this section. The flora was still of the hardwood variety such as oak, elm, and cottonwood, but there were additions of hickory, sycamore, and Osage orange (bios d:arc). Fauna which was present included buffalo, elk, deer, wolves, badger, rabbits, beavers, raccoon, cougar, opossu, and squirrels, plus ducks, wild pigeons, and turkey.

Within the area and its subdivisions just described are found the archaeological remains of extinct groups of peoples and their cultures. These remains most often consist of stone tools, bone tools, materials made of pottery, and - in some instances - the bones of individuals who had functioned in their respective culture. A comparison of these cultural remains shows many similarities as well as many dissimilarities. A thorough analysis and study of these cultural remains would lead, most naturally, to the conclusion that there were many different cultures within which there was much individuality, while outwardly there was much that was similar when compared with each other. Collectively, all these cultures comprise what is known as the Central Plains Tradition or the Central Plains Complex. Just what is the Central Plains Tradition made up of? Throughout the Central Plains (even though it has diverse topography, flora, and fauna) were located areas of Indian habitations which are believed to have been prospering from 1150 AD to 1550 AD (Wedel 1959). Archaeologists have named these various cultural assemblages which were flourishing during this era. These cultures are the Upper Republican, the Smokey Hill, and the Nebraska. They are all similar in that each seems to represent a semi-horticultural people who lived in small villages in the valleys along the stream courses of the Central Plains. The people practiced hoe farming of such items as corn, squash, and beans. Their livelihood also depended on the hunting of such animals as the bison, deer, antelope, elk, and all sorts of native small game. Their life was not nomadic because they lived in semi-permanent villages and planted their crops in nearby fertile valley fields. It is quite reasonable to assume that they did move, but this action probably did not occur more than once in every two or three generations; their reasons for moving could be one or a combination of many things, such as crop failures, attacks by roving hostile bands, or perhaps just to satisfy the wanderlust of finding out what was beyond the next hill or around the next river bend. Their villages were rather sporadically spaced along the streams, but almost all villages were located on terraces or bluffs that were close to water supplies, yet out of danger from sudden flooding. All the village sites show that there was no standard pattern for the establishment of the village (Martin, Quimby, & Collier 1947). Instead, the earth lodges seem to be more or less randomly situated on favorable locations, which in general tend to run parallel to stream courses. Their lodges have a general consistency in form, in that they were circular or rectangular with dome-shaped roofs of poles, brush, or clay and poles, clay and brush, or possibly skins. The artifact assemblages of these various cultures are similar in a general way. The types of tools found necessarily relate the economic endeavors of these people. Therefore, these horticultural peoples have such tools as bison scapula hoes, antler digging sticks, grain grinding tools, and pottery. Tools related to hunting are arrowheads (of which there were many different types), snubonosed scrapers, side scrapers, ovate knives, elliptical knives, diamond-shaped beveled knives, drills, celts, axes, mauls, hammerstones, bone awls, bone needles, arrowshaft smoothers, antler flakers, stone pipes, pottery pipes, shell disk beads, shell pendants, and a host of other artifacts. It should be emphasized that all the artifacts which comprise one culture do not always have the same form in another culture. Cultural variations naturally should occur, and they do occur. The important fact to remember is that all the Central Plains cultures had tools, although not always similar in form, for the same general uses. The people, their tools, their houses and villages, and their livelihood are what comprised the Central Plains Tradition.

At this point it is necessary to make some statements which will tend to bring some discontinuity into the picture. Of prime importance is the fact that not all the cultures of the Central Plains were flourishing at the same time although present interpretations seem to show that most of them were flourishing for some time in contemporanuity with each other. There is also evidence of new groups which moved out onto the Central Plains, and these new groups brought new ideas and new items with them. Another important fact is that certain locales in the Central Plains were not inhabited during certain time periods within the era from 1150 AD to 1550 AD. There is also the inference that the peoples of the Central Plains cultures shifted to new areas during the course of time, and that as these people tended to be rather isolated, they developed along special lines. Therefore, it must be understood and remembered that the study of the Central Plains Tradition entails some inference and hypothetical work which enables a presentation of rather understandable descriptions of the cultures in relation to time, the people and their origins.

The question with which this paper is concerned is that of the origins of the artifacts, materials, and traits which make up the Central Plains Complex. Perhaps the first question that should be asked and dealt with is: is it not possible that items which comprise the Central Plains Complex also have their common origin in the Central Plains area? By no means is this an illogical question. It is not difficult to formulate the hypothesis that the items within the complex do have their common origin in the Central Plains, and during the passage of time these items could have diffused out over a broad geographical area. This diffusion would be greatly aided by the general uniformity of the area and the general uniformity of the type of economic activities with which the prehistoric Indians were partaking; such problems as acceptibility and adaptibility by the Indians of those items would not be very important in limiting the spread of those items. At present, though, archaeological study does not support the hypothesis that the Central Plains Complex had its origin within the Central Plains. In fact, the archaeological evidence tends to show that the Central Plains Complex had its origins in other areas of the United States. Therefore, it must be stated that the Central Plains Complex did not have its origin or origins within the Central Plains. When one theory does not apply then another theory should be formulated and tested.

The second possible theory was easily formulated and is simply the deduction of the analysis of the first theory: the origins of the first theory; the origins of the Central Plains Complex were located outside of the Central Plains. This is the theory that is most widely accepted by archaeologists and anthropologists, and it is this theory which is currently being proved by means of archaeological work and research. The current problem is where to look for these origins. From present study and evidence there seems little chance that the major traits found in the cultures of the Central Plains had their origins to the west or to the north of the Great Plains. Several reasons are involved in making this statement. Archaeological work in the west has revealed that the early (9000 BC to 200 AD) cultures in Colorado and Wyoming were more or less based on a hunting and gathering economy, and were nomadic. Therefore, these early cultures were not agriculturalists and were not living a settled existence. They did not possess such traits as corn growing, semi-permanent villages, or houses. In fact, these hunters and gatherers were essentially the same people that were occupying the Central Plains before the period of the Central Plains Complex with which this paper is concerned. The area north (North Dakota, South Dakota, and Montana) of the Central Plains cannot be considered as the source either, because its early cultures were also of the hunting and gathering type. Also, present evidence shows that the agricultural systems which did develop in this area were derived mainly from the agricultural (actually horticultural) systems which influenced the Central Plains. Why would it not be possible to theorize that the Southwest area gave rise to the Central Plains Complex? The Southwest area was flourishing with a type of non-nomadic culture that was centered around corn horticulture about 800 AD (Wormington 1956), and this time period is somewhat prior to the rise of the Central Plains Complex. Why cannot the archaeologists say that the Pueblo area fostered and stimulated the cultures that developed in the Central Plains at around 1150 AD or even a little before that date? This theory cannot be accepted because there is not enough evidence to support it, and there is too much evidence against it. If the corn economy of the Pueblo area had been the stimulus for the Central Plains cultures there would be a great many of the Puebloan traits found associated with the Central Plains economy. Items like village patterns, house patterns, pottery types (especially shapes and decorations), and tool types which are associated with Pueblo cultures of 800 AD should be found in the cultural assemblages of the Central Plains cultures of around 1150 AD. But these Puebloan traits do not appear in the assemblages of the Central Plains cultures (1150 AD - 1550 AD) except for very infrequent trade items such as turquoise beads or pottery vessels or the adoption and use of the mano and metate. "The origins of the Central Plains tradition remain to be worked out. That it is basically of eastern or southeastern derivation seems clear."[1]

The basis of the Central Plains Complex seems to be that of the Early Eastern Woodland cultures of the present states of Iowa, Missouri, and Illinois. These cultures were present in the eastern United States about 500 BC. Life in the Woodland cultures was centered around hunting and gathering, and therefore the people tended to be nomadic in their way of living. Their villages were of the type that could be moved or easily left behind, and their homes were probably of brush and poles, or hides and poles, although this is an inferred statement because these features or characteristics have not been verified due to their more perishable nature. It was the later (around 1 AD) horizons of the Woodland cultures that migrated west along the various stream courses that lead to the Central Plains area. Why did these Woodland peoples migrate west? There are several factors which could have been in operation at the time. It is possible that these people were simply following their normal sources of food supply or searching for more abundant sources of food. It is also possible that the Hopewell cultures which developed and arose in the Ohio-Illinois area around 100 BC or 200 BC were forcing the less advanced peoples out of the area. It is also possible that at circa 200 BC there was enough of a population increase exerting pressure on marginal peoples and causing them to move from the Ohio-Illinois area to places which were not as crowded and which could support extra people.

By 1 AD the Early Woodland cultures had pushed westward to the eastern borders of the states of Nebraska and Kansas. The present archaeological evidence shows that these Woodland cultures were mainly concentrated in the Nebraska-Kansas-Iowa-Missouri area. In this area they practiced a subsistence based chiefly on hunting. Their houses were circular, probably of poles covered with skins or mats, and contained a central fireplace. Pottery making was practiced, and the type of pottery was dominated by cordmarked, cylindrical-shaped, rounded-bottom vessels which were tempered with crushed stone and sand. Burials of the Early Woodland peoples are semi-flexed (Hill & Kivett, 1940). These people used the bow and arrows and also the atlatl or spear thrower, and most of their artifact assemblage pertained to a hunting economy with such items as scrapers, knives, dart points, arrowheads, bone awls, and flint knives. There are two important facts associated with the Early Woodland cultures. The first is that Early Woodland sites underlie known pottery complexes that practiced horticulture. The second fact is that the Early Woodland cultures brought to the Central Plains cordmarked pottery and circular homes of log or pole superstructures with central firepits.

Burial mounds and village sites of Hopewell have been found as far west in Kansas as the present town of Ellsworth which is near the 98th meridian on the Smokey Hill River. The items which the Hopewell peoples introduced into Kansas were mainly those items associated with the horticulture-hunting complex. It should be noted that the Hopewell peoples had a great influence on neighboring descendents of the Early Woodland cultures. The deer scapula hoe of Hopewell was adopted by the late generations of the Early Woodland peoples but in the adoption, bison scapula replaced deer scapula probably since bison were more plentiful in this area than deer. The Hopewell people were also very influential in their pottery styles; the pottery remained cordmarked but was thinner and the paste was of better quality. The Hopewell village organization was probably loose, and villages were unfortified since there were no fast-moving preditory Indians at that time. Important artifacts associated with the Kansas Hopewell are: wooden digging sticks, rocker stamped pottery, arrowheads of ovate-triangular shape, chipped end and side scrapers, flint drills, bone needles, bird bone beads, and bone awls.

The Hopewell peoples who migrated up the Missouri River moved north almost to the Nebraska-South Dakota boundary in the area of the Missouri River. Then they seem to have started moving westward along the various stream courses of Nebraska which empty into the Missouri River. During their settlement along the Missouri River in the area of Iowa-Nebraska-Kansas, these Hopewell peoples had a great deal of contact with Early Woodland peoples in the same area. These two cultural groups tended to intermingle and fuse with the passage of time. The Hopewell groups brought the idea of maize horticulture to the area, and the Early Woodland peoples were quick to adopt it. The Hopewellians also brought to this area such items as bone fishhooks, pottery effigies, polished celts, deer scapula hoes, metapodial beamers, pottery elbow pipes, smooth exterior pottery which replaced the typical cordmarked wares of that area, and the rest of the artifacts which are found in the Hopewell sites in Kansas. Houses of Hopewell were circular or poles and brush or poles and bark with interior cache pits. The locations of villages are very sporadic, and there is no definite pattern of village organization. From the archaeological findings, it would appear that it was not at all difficult for the Early Woodland peoples to adjust to the new type of semi-permanent village life based on horticulture and hunting. At least there is not a great amount of evidence supporting physical strife between the two cultures.

All these features of Hopewell expansion and fusion with the Early Woodland peoples started around 200 AD and persisted till around 1100 AD at which time a new "hybrid" culture arose from the mixture of the Early and Middle Woodland cultures. This new culture is known as the Nebraska aspect.

The Nebraska Aspect was situated in the eastern half of the present state of Nebraska and was contemporary to the Upper Republican Aspect of north central Kansas and south central Nebraska (Strong 1933). It would therefore seem that the existence of the Nebraska Aspect was from about 1100 AD to 1400 AD. The Nebraska Aspect and the Upper Republican Aspect maintained trade with each other. Traits acquired from Upper Republican were chipped celts, antelope mandible sickles (graters??), triangular side and base notched arrowheads, certain pottery design elements, diamond beveled knives, arrowshaft smoothers, and awl sharpeners. Some of the western fringe peoples of the Nebraska Aspect also adopted the earth lodge (four central roof supports and a large central fireplace) of the Upper Republican Aspect. The Hopewell-Early Woodland village settlement (on terraces along streams, unfortified, and unorganized) was continued by the Nebraska Aspect. The village economy was centered around corn horticulture and hunting. Horticultural tools are the bison scapula hoe (instead of the Hopewell deer scapula hoe), wooden digging sticks, and a few bison horn-core hoes (possible Early Woodland origin?). The Nebraska peoples did not adopt the Southwestern mano and metate but used the muller and milling basin for grain grinding. The pottery was globular shaped, with a smooth exterior, and clay tempered. Two new traits appear in Nebraska pottery. Strap handles were made on jars. The handles have their origin in the Middle Mississippi Valley. Also new were incised design elements on lip or rims. Some of these design elements have origins in the Upper Republican Aspect while others again point to Middle Mississippi Valley influence. The Nebraska Aspect also had such artifacts as bone awls, bone fishhooks, cylindrical bone beads, and polished celts which seem to represent carryovers from Hopewell. There is much Middle Mississippi influence in shell work such as shell pendants, triangular shell gorgets, and short tubular shell beads.

The Hopewell Peoples were not the only ones to bring the hoe-corn complex to the Central Plains. Archaeological evidence supports the fact that village horticulturalists were expanding out of the Arkansas-Oklahoma area and the middle Oklahoma area at a time around 850 AD. These southeastern and southern peoples entered the Central Plains by traveling northwestward and north through Kansas, and seem to have arrived in the Central Plains area after the Hopewell cultures in this area had died out or been absorbed. These people seem to have absorbed some of the Hopewellian ideas, and they also introduced traits which are typical of the area from which they came. Their most important contribution to the Central Plains Complex was the earth lodge with four central roof supports, rectangular in shape (rounded corners), extended entryway, and interior and exterior cache pits. Other tools of southern derivation are bone punches, possibly bone shaft wrenches, arrowhead styles, and possibly the diamond beveled knife.

It is the opinion of such archaeologists as Spaulding and Wedel that the Smokey Hill Aspect (dated at about 1000 AD) located in the east-central portion of Kansas represents the end result of the fusion between the Early Woodland, Hopewell, and the Arkansas-Oklahoma cultures. In looking at the cultural inventory of the Smokey Hill Aspect, one can see the various influences of the three previous cultures. Influences of the Early Woodland are the cordmarked pottery, the semi-flexed burials, and circular houses built on log or pole superstructures. Hopewell traits are present in the form of finer quality pottery (cordmarked in Early Woodland fashion) with collared rims and tool-impressed decoration, polished stone celts, maize agriculture, chipped scrapers, small triangular projectile points, shell disk beads, mussel shell pendants, bone beamers, long bone awls, and unfortified villages with loose village organization. Smokey Hill cultural traits which have their origins in the south and southeast are: earth lodges (described above); bone punches; bone shaft wrenches; arrowhead styles; diamond beveled knives; long, thin lanceolate knives; ovate knives; chipped celts; mullers and milling basins; and flexed burials. There are several important Plains artifacts which seem to have their origin in the Smokey Hill Aspect. These items are the grooved shaft smoother, ossuary burials, and possibly the diamond beveled knife, and the bone single-hole shaft wrench. These last two items appear almost at the same time in the Southern Plains and in the Central Plains, and it is very difficult to really pinpoint their origin. These four items appear in the Smokey Hill cultural assemblage and persist and spread throughout the Plains area in later cultures.

From the continuous development which must have taken place in the Smokey Hill Aspect there arose a new Central Plains culture: Upper Republican. The Upper Republican Aspect probably existed from 1150 AD till the time of white contact. The historical Upper Republican culture was probably the same as the historical Pawnee Indians of central Nebraska. The geographical location of the Upper Republican Aspect was in the river valleys and tributaries of the Solomon River (Kansas), the Republican River (Kansas and Nebraska), Saline River (Kansas), Smokey Hill River (Kansas), and the Loup-Platte River area (Nebraska). The economy of the Upper Republican villages was based primarily on maize horticulture, hunting, and some gathering. Villages were semi-permanent, unfortified, and arranged in no definite pattern. Houses were of the earth lodge type being rectangular in shape with rounded corners, central fireplace, extended entryway, and four central roof supports. The pottery was globular in shape with cordmarked exteriors and some incising being present on rims and the lip area. Their tools consisted of bison scapula hoes, triangular arrowheads which may be unmodified or have side and base or just side notches, elliptical knives, diamond beveled knives, chipped end and side scrapers, bone single-hole shaft wrenches, arrowshaft smoothers, bone awls, chipped and polished celts, milling basins and mullers, hammerstones, and ossuary burials. Most of these items relate back essentially to the Smokey Hill Aspect.

Upper Republican maintained much trade with the Nebraska Aspect peoples to the east, and from this trade Upper Republican acquired bone fishhooks, rim and lip incising on pottery, the idea of strap handles on pottery vessels, elbow pipes, and metapodial beamers.

Late peoples of the Upper Republican Aspect migrated towards the southwest and brought the Upper Republican culture to the Texas-Oklahoma panhandle area (Wedel 1947). In this area around 1300 AD the Upper Republican peoples came in contact with Puebloan influences. Antelope Creek Focus and the Optima Focus seem to represent Upper Republican peoples who had adopted the Puebloan style of architecture plus the Southwestern mano and metate. The mano and metate then diffused back into the Central Plains area.

I think the archaeological picture shows that the cultures of the Central Plains area have many similarities of artifacts. This suggests a general prehistorical background which was similar. It also suggests that contemporary cultures of other areas were having much influence on the various cultures which were found in the Central Plains during the period from 1150 AD to 1550 AD. In a general manner one can sum up the archaeological picture of the Central Plains Complex by saying that the majority of the artifacts and influences have their origins in the east and southeast areas from the Central Plains.

Notes:

[1] Waldo R. Wedel, An Introduction to Kansas Archaeology, Bulletin #174 Bureau of American Ethnology, p. 628. Smithsonian Institution: Washington, D.C., 1959.

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A POSSIBLE GEOPHYSICAL METHOD
OF LOCATING ANTHROPOLOGICAL EVIDENCE

By

SAM COHEN

Introduction:

The purpose of this paper is to outline a method of geophysical prospecting which may be of aid to the physical anthropologist in his never-ending search for ancient man.

As far as can be ascertained through diligent research, this method has been applied to anthropology but once, although it is a common device of the prospector in searching for metalliferous ores.

In February of 1947, H. Deterra reported the discovery of a skeleton on the shore of an old lake at Tepexpan, Mexico. In this paper Deterra stated that the location of the area was chosen after a geophysical survey of the region had been made by Dr. Hans Lundberg, a Canadian geophysicist. Deterra describes the location thus: "The spot marked the point of greatest electrical resistance offered to an alternating current artificially introduced into the ground in the manner of the linear electrode method."[1] With this and other information and a few pictures in Life Magazine, an attempt has been made to reconstruct the principles of the method, and to present the details of the necessary equipment used. This is done so that a similar instrument may be made at some future date for use in other areas, wherever it may be deemed applicable.

Outline of Theories Involved:

The method used is that of the determination of surface potentials which are set up by passing alternating current through the ground between a pair of electrodes. The current field may be represented by Figure 1. At right angles to the current lines there is an infinite number of equipotential lines. Roughly, the principle involved is that as these current lines are attracted toward any conducting body the equipotential surfaces are repelled from it (figure 2). It is these variations in the equipotential surfaces which are plotted at their outcrop by means of a simple portable circuit. This circuit, called the Flying Circuit, consists of two electrodes, for making contact with the ground connected by 100 feet or so of insulated wire, a pair of earphones, and an amplifier.

Layout of Equipotential Line Survey:

The electrodes may be spaced any distance apart, although the object is to have as little curvature in the equipotential lines as is possible. The electrodes should be spaced a mile or more apart for best results (figure 3). The equipotential line survey is restricted to the rectangle "a", "b", "c", "d", and no attempt should be made to plot lines within 1/4 "ab" of the electrodes, as the lines are too curved to be really effective. It must be remembered that non-conducting bodies will act in exactly the opposite manner, causing current lines to be repelled and equipotential lines to be attracted to the body.

Electrodes:

There are two types of electrodes which may be used for passing the current into the ground. These are called the point and the linear electrode systems. The simplest form of point electrode would be a metal spike driven into the ground, but due to the high resistance offered by a single contact of this kind, it is impractical. In order to reduce this contact resistance, the point is changed to a multipoint arrangement (figure 4), which is a mere grouping of a series of spikes, in any pattern, at the spot that is chosen for introduction of the current into the ground. The actual number of contact points required will depend on the amount of moisture in the surface formations. The more moisture the ground contains, the fewer the number of contacts that are required. Although the area covered by each of these multi-point electrodes is considerable, the dimensions are actually very small compared to the distance between the groups.

The linear electrode system (figure 5) is a special case of the multi-point electrode in which each electrode is a single length of bare copper or iron wire laid out in a straight line on the ground and pegged directly to the ground in the same manner as the multi-point electrode. The spacing of the metal spikes depends on local conditions such as the humidity of the ground. In areas where the humidity of the ground varies over short distances, it is possible to regulate the potential drop along the length of the linear electrode by increasing the number of contacts over dry areas and decreasing them over wet areas. Further control can also be effected by connecting the insulated cable from the current source to a number of points along the line of the electrode, instead of at one end only, as shown in figure 5. It must be noted that the length of the linear electrodes should be roughly equal to the distance between them.

This method has several distinct advantages over the point electrode system.

1. The equipotential traces at the ground surface appear as a series of parallel straight lines instead of curved lines as in the case of the multi-point system.
2. The distance between electrodes is much more variable as a result of No. 1. The only consideration necessary is to keep the length of the electrodes equal to the distance between them.
3. As depth may be more or less controlled by varying the distance between electrodes, it is at once evident that the linear type electrode is more applicable for the shallow depths which will be surveyed by the instrument in the search for anthropological evidence.

It is believed by the author that the linear type electrode would be of greater practicability and economy even though more moisture is required for its use. Experience would no doubt dictate the choice of electrodes for given areas.

Interpretation of Results:

As all these measurements are qualitative and no further computations are required than the actual marking of equipotential lines on the ground, it is a relatively simple matter to make direct interpretations of results. Several things must be kept in mind however; the nearer the conductive body lies to the surface of the ground the more pronounced will be the flexures of the equipotential lines.

It must also be remembered that indications may be caused by various agencies other than bones. For example, a boulder having a different resistance value than the surrounding sediments may cause flexures; or, patches of wet earth below the surface may cause the soil to have less resistance than the drier earth around it. It is readily seen therefore, that interpretation of an equipotential survey is imperical in nature. The more experience the operator has, the better the interpretation.

Construction And Method Of Operation:

The equipment for a survey of this type consists of an A.C. generator, a small gasoline-driven motor, a set of steel stakes, suitable lengths of insulated cable and bare copper wire, two steel rapiers for the flying circuit, and an amplifier, and a set of earphones.

A.C. Generator and Motor: The generator should be of a type which will deliver current at a frequency of about 500 cycles per second and about 350 watts. The current used may vary from 100 watts to 500 watts but must be constant during use. A small one-cylinder motor should be sufficient to drive the alternator.

Electrodes: The stakes used for securing the electrode wire to the ground may be made very easily from a twelve-inch length of 1/2 inch mild steel rod; one end should be pointed and the other end bent at right angles, or completely around. The wire may be soldered directly to the stake for better contact, and the stake should be driven into the ground to a depth great enough to pin the wire securely to the soil. If resistance is high, longer strokes may be used to reach damper ground.

Cable: Multiple-strand insulated cable should be used to connect the electrodes and the generator. From fifty to one hundred feet of insulated, light-weight wire will be necessary for the flying circuit and suitable lengths of bare copper wire will be needed for the electrodes. The lengths of bare wire required will depend on the length of linear electrodes.

Flying Circuit: The flying circuit consists of two rapiers connected by fifty to one hundred feet of insulated wire, an amplifier and headphones. The rapiers are made of three feet of 1/4 inch steel rod pointed at one end and having a wooden handle on the other. The wire is attached to the rapiers by means of brass terminals. The amplifier used must be very light in weight, and as no use is made of harmonies, a tuned amplifier is unnecessary. Instead, a light, resistance-capacity coupled amplifier may be used. It should be fitted into a carrying case which is then placed on the back of the operator. The headphones are plugged into the amplifier which is in turn connected to the flying circuit.

Operation: After the linear electrodes have been properly placed and current introduced into the ground, the assistant embeds the rear rapier into the ground and the operator moves ahead to the extent of the connecting wire. The operator makes several trial contacts with his rapier trying to locate the point of least sound in his earphones. He then marks the spot and the assistant moves up to this point where he embeds the rear rapier. This process is continued to the extent of the electrodes. It may be more advantageous to first lay out a base line which is divided into twenty-five or fifty foot intervals and numbered consecutively. These intervals may then be used as starting points for each equipotential line. As the line is traced out, the assistant marks points of minimum sound with numbered wooden stakes. Upon completion of this area the stakes are surveyed and any divergence or convergence is marked.

Examination Of Old Sites And Applicability Of The Instrument

Folsom Site: The original discovery of Folsom points was made in a little valley on the east flank of Johnson Mesa about twelve miles east of the city of Raton, New Mexico, and fifteen miles west of the village of Folsom. The little valley leads down into larger and larger valleys to a main stream valley that flows eastward toward the town of Folsom. These valley tributaries have grassy floors fifty to one hundred feet wide, and are bordered by terraces about twenty-five feet high, cut on the Cretaceous shale bed rock. One of the streams has cut into the valley floor exposing a good section of the deposits. Folsom points were found about four feet below the surface at this point.

The material in which the points were found is a clay alluvium containing lenses of dirty gravel composed mostly of sandstone plates. It differs from material now being deposited in similar valleys only in having small limey concretions. This clay layer may also be found in the valleys of several other small streams in the area.

It is the opinion of the author that an equipotential line survey would be of great value in this area. The only difficulties which would be encountered would be due to an over-abundance of bison bones, twenty-three skeletons having been reported from this layer. The gravel lenses may also cause some difficulties, but experience should soon teach the operator to differentiate between bone deposits and gravel deposits. The survey in this area would of necessity require a great number of movements of the electrodes, as the area under examination is reported to be one hundred feet wide at most, and the electrodes can be no longer than the distance between them.

Lindenmeier Site: This site is located near the Wyoming-Colorado line and is on the contact between two nearly flat-lying Tertiary formations, the sandy Arikaree and the tuffaceous Brule. This contact is marked by a spring zone which may have been responsible for attracting Folsom man to this site. The geology is very complex at this site, making age correlations very difficult. The only method of determining the age of the deposits containing the cultural remains of Folsom man is apparently dependent on the ability of geologists to trace successive terraces downstream to the South Platte River.

The layer which contains the culture was formed during stage five of the seven stages responsible for the present physiography of the area. During the two stages following the formation of the cultural layer, the area was reworked by streams and deposition again took place. This causes the cultural layer to be eroded in some places and buried beneath twelve to fourteen feet of accumulated material in others. It is due to this fact that it would be nearly impossible to conduct an equipotential survey in this area. Not only is the culture layer eroded in some places, but where it is covered, the sediments are of a coarse hererogeneous nature, believed to be of glacial origin.

Vero Site: Human remains were found near Vero on the Atlantic Coast in central-eastern Florida. The remains were found in the banks of a drainage canal in the valley of the Indian River. The bed rock in this area is a marine shell stratum known as the Anastasia formation. Overlying this shell bed is a sand deposit termed the Melbourne bone bed. This sand layer is from one to five feet thick and is strongly cross-bedded especially at its base. This formation contained many vertebrate fossils. Resting on this sand bed and in places cutting into and even through it, is an alluvial deposit consisting chiefly of vegetable material intermixed with sand. The average thickness of this alluvial material is about two feet, although where the stream cuts into the underlying bed it may be five or six feet thick (figure 6).

An equipotential survey would be of great value in this area and should be very easy to conduct. The main difficulty here would be flexures of the equipotential lines caused by crosional remnants below the surface. Another difficulty which may be encountered in this area would be caused by the aridity. This could be overcome by using a multipoint electrode system instead of the linear and also by lengthening the potential stakes. It seems quite probable that a multipoint electrode could be inserted along the banks of Indian River and would tend to remove a great deal of the difficulty.

Clovis Site: This site is located approximately one hundred and sixty miles southeast of Folsom, between Clovis and Portales, not far from the Texas-New Mexico border. Folsom points were found in shallow depressions which were once filled with water. These basins dried up and were filled with drift sand. Recent wind and water action has left them in varying stages of erosion. The sand has been whipped up into dunes, exposing a hard bluish-gray deposit. In some of these basins the bluish layer has been cut down to a harder underlying layer of caliche, leaving erosional islands scattered through these basins. Excavations in these islands yield animal bones, stone artifacts, bone tools, charcoal and ashes.

Geological evidence indicates that the blue-gray stratum in the Clovis region was a lake deposit, probably laid down when temperatures were lower and there was much more precipitation.

The linear method of equipotential survey would probably not be practical here due to the aridity of the region, but it would be possible to conduct a survey by use of multipoint electrodes and then the electrodes would probably have to be wetted down with an electrolytic solution.

Plainview, Texas, Site: During the summer of 1944, Glen Evans and Grayson Meade discovered a fossil bone bed in a gravel pit near Plainview in Hale County, Texas. The gravel pit is located on the south margin of the valley of Running Water Creek. The road material utilized is caliche and calcareous clays from the Panhandle formation, a strata of Pliocene and early Pliestocene age. This formation forms the bed rock of the valley. The excavated portion of this bone bed which is in the alluvial fill of the valley, is sixty-two feet long. It is also exposed at Plainview, in several other gravel pits nearby, and in a drainage canal.

The stream valley is entrenched twenty to forty feet below the plains level and has an average width of between a quarter and a half of a mile. The floor of the valley is covered by from ten to twelve feet of alluvial fill.

The present river has cut a feeble channel from two to four feet deep into this fill. The fill itself consists of a basal zone of cross-bedded sands and water-worn caliche gravels, from a few inches to three and one half feet thick; an intermediate zone of massive, compact, sandy clay, five to eight feet thick; and an upper zone of dark sandy soil one and a half to three feet thick.

This site seems to be the ideal place for an equipotential search. It has nearly all of the required characteristics. The sediments which contain the bones and points are very homogeneous in nature. The greatest difficulty which would be encountered would be the innumerable bison bones located in the bone-bed. This bone bed has an average thickness of one foot, and skeletons and partial skeletons of one hundred bison were found in an area of about five hundred square feet. This would deem a survey of this area practically worthless, but if the accumulation of bison bones was caused either directly or indirectly by man, as proposed by Sellards, then it may be worthwhile to survey the area around the bison bed in the hope of locating a possible campground of the hunters.

San Jon Site: The excavations in the San Jon area are located on the north rim of the Staked Plains, ten and a half miles south of the town of San Jon, and twenty miles south of the Canadian River. At this location there is a shallow basin that is apparently a remnant of an old filled-in lake that was formed in the fill, when an original valley in the escarpment was blocked by sands. Heavy erosions in the area in recent years has exposed deposits of alluvium and local concentrations of animal bones and man-made objects, such as points and scrapers.

The deposits of the basin form a complex sequence of eleven stages, all related to the filling of an original valley with layers of sand. The last, or present, stage is characterized by deep erosion. Preceding this, there was deposition of a coarse alluvium that remains as terraces. The layer below this is composed of alluvial fill consisting of reddis clay and sand. It is marked by deep, narrow arroyos. There is an unconformity between this and the underlying layer, which is composed of a sequence of clay, red sandy alluvium, and clay. This represents the lowest level containing other animal or human evidence. Below this is a layer of volcanic ash, resting on iron cap and associated clays. The iron cap and clays were laid down in the hollows in the top of the white and buff cross-bedded sand, filling the basin-like valley that had been formed in the top of the Tertiary beds underlying the area.

This area is probably the worst encountered to date for an electric survey of the type proposed. The underlying iron-containing formation would probably conduct all of the induced current. The only flextures obtained would probably be a result of minor structures in the formation or in stratigraphic changes in the amount of iron contained in the bed. All indications of bones in the overlying strata would be masked as a result of the iron-bearing formation.

Scottsbluff Bison Quarry: This site is located within a few hundred yards of the base of Signal Butte, sixteen miles west and three miles south of Scottsbluff, on the north bank of Spring Creek, about fifty feet east of the juncture of Kiowa Creek. Spring Creek has cut a trench into an old river channel which is composed of coarse gravels which contain bison bones and artifacts. This fossil river has cut into the Oligocene Brule clay, and its gravels vary in size from ordinary sand and pebbles up to chunks of Tertiary sandstones and clays weighing fifty pounds. This coarse material is overlain by finer material composed of sand and silt. When the stream ceased flowing, a covering of from twelve to twenty-seven feet of wind-blown material was deposited in its channel.

This site would not be very well adapted to an electrical survey of this type as the bones are located in the basal part of the fill which is not only covered by twenty to thirty feet of material in some places, but is also very heterogeneous in character. These large boulders would no doubt interfere with induced currents and difficulties would probably arise. It does seem possible, however, that work could be carried on in areas that have exposed by Spring Creek. The linear type of electrode would more than likely have to be replaced by a multipoint electrode. One electrode could very easily be placed in the moist earth on the banks of the creek and resistance would be minimized at this point.

Pinto Basin Site: The Pinto Basin proper is a large desert drainage system in the north-central part of Riverside County, California. Only the lower third of this basin is described here. This part of the basin contains the Pinto Wash, which runs in an easterly direction towards the mouth of the basin.

The Pinto BAsin contains four stages of sediments. These were deposited during Quaternary time in the following order:

1. The Pinto formation, composed of lacustrine clays, sandstones and gravels interstratified with basalt flows, and represented in part by a very coarse fanglomerate.
2. Poorly sorted coarse sandstones and gravels made up of reworked Pinto formation material, are termed "intermediate gravels."
3. Later gravels composed of coarse fan material derived from the nearby mountains.
4. Sand-dunes, recent fans adjoining the mountains and material in the beds of present washes, go to make up the "Recent Alluvium."

This basin was apparently occupied by primitive man during a period when there was a large lake-like body of water in the basin. This lake may have actually been a very slow flowing stream. Campsites of these prehistoric people have been found along the old banks of this stream. All of the archaeological evidence which has been found to date has been located at the surface, but no human bones have been found as yet.

From the appearance of this basin, it would be very difficult to conduct an electrical survey here. The extreme aridity of the area during most of the year would make it very hard to induce electricity into the ground. This problem could be overcome by the use of an electrolytic solution at the inductance points. Another problem which would be encountered here would be due to the lava flows, which appear to underlie a great deal of the region. These lava flows, combined with gravel deposits, would probably so interfere with the normal flow of current that it would be next to impossible to interpret results. It does seem possible to the author, however, that through careful choice of locations and the use of water on the electrodes, a fairly good survey could be made.

Conclusions: This portion of the paper will be devoted to a brief summation of the advantages and disadvantages of the instrument, and a program of its use. It must first be stated, however, that the instrument herein proposed is but an adaptation of the method used in the search for metalliferous ores. Experience will no doubt dictate adaptations and further changes in some of the methods. As the author has never had any personal experience with this type of survey, all statements made regarding its use in any particular area are purely theoretical, and will probably have to be revised as experience in its operation is gained.

Disadvantages:

The moisture content of the ground under survey must be relatively high, otherwise difficulty is encountered with the electrodes. This may necessitate a different type of electrode, or in extremely dry areas, the use of watering devices for wetting down the electrodes.

As the current tends to flow near the surface, the topography quite often affects the equipotential lines. This limits the use of the instrument to relatively flat land.

A further limitation placed on the instrument is brought about by heterogeneous sediments. In areas which have been glaciated the sediments often contain large boulders. If these boulders are close to the surface, they would cause flexures of the equipotential lines which would resemble those caused by bones. The sediments do not have to be extremely homogeneous, although best results would be obtained from this type of material.

There is apt to be ambiguity of the results. A small conductive body close to the surface would no doubt give the same results as a large conductive body at greater depths. This would be minimized, however, as experience is gained in interpretation.

Advantages:

It is the opinion of the author that this instrument is of high value to the anthropologist. While its results may not always be positive, it is a tool which may aid in the location of a great deal of anthropological evidence and could be used extensively. The instrument is portable and cheap, and should be an integral part of the equipment of every field party. Interpretation of results is very simple and may be done in the field with no further computations. No particular skill or knowledge of electricity is necessary. In all, it is a very simple method and at the same time may be of great value.

Program of Use:

The necessary equipment could probably be obtained on the campus and an instrument of this type made. Before it is used in the field it would be wise to become familiar with its operation and interpretation of results through controlled experiments. This could be done in various ways, such as burying objects at different depths and then relocating them with the instrument. Experiments should also be conducted to ascertain the optimum moisture content of the ground and the best electrode system to use under various conditions.

With little knowledge of the climate in the area, it would appear that the best time to conduct a survey of this type would be in the spring or late fall when the moisture content of the ground is relatively high and uniform. Various problems will probably arise, but due to the simplicity of the equipment, and with a thorough knowledge of the principles involved, these problems should be overcome easily by making minor variations in the technique used or in the equipment.

Notes:

1
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Editor's Note:

Unfortunately, the illustrations accompanying this paper have not been reproduced due to difficulties beyond our control. The paper originally (1961) held three illustrations, each divided into sub-illustrations. We were not able to print them.

SOME ARCHAEOLOGICAL EVIDENCE OF THE DISTRIBUTION OF COTTON IN THE AMERICAN SOUTHWEST AND ACCOMPANYING CONJECTURE

By

JAMES W. HESTON

One of the more interesting problems in the archaeology of the Southwest has concerned the origin and date of origin of cotton cultivation, especially in view of the advantage of cotton fibers over those of apocynum and yucca and the late date at which cotton appears to have come on the scene. The original purpose of this paper was hopefully, to clarify the situation to some extent. This has been rendered impossible by several difficulties, not the least of which is the relative incompetence of early archaeologists in the southwest.

Since there are many species of cotton, it should first be specified that the cotton in question has been classified as Gossypium hopi hereafter known as G. hopi. According to Jones (1936:56) and Carter (1945:80) this is the only specie which has been positively identified as being cultivated by the various cultures of the Southwest. It is not related to the wild cottons of the area but a relative of G. hirsutum, the uplands cotton on which the Southern states cotton economy is presently based. Sir George Watt (1907:227) states that, "...I am convinced the best uplands cotton would be more correctly viewed as cultivated forms of this plant rather than as forms of G. hirsutum." This was in reference to his classification of G. mexicanum, of central Mexico. This would argue for Mexican or southern origin of the cotton of the Southwest as does the fact of the early cultivation of cotton to the south and as does the lack of any wild cottons from which G. hopi might have derived, in the area in question. Carter, in the same paragraph, notes that there is little resemblance between commercial Mexican cottons and proposes that there might have been a separate derivation.

There lies a possible confusion factor in the extremely short maturation period of G. hopi, which would seem to be adapted to northern climate and/or high altitude. This might, however, have been originally an adaption to drought conditions, allowing the plant to seed with a very short period of adequate moisture. This phenomenon has occurred before in other plants, and even in certain amphibious vertebrates, e.g., the spadefoot toads.

Another question raised by Carter is that of the complex with which the cotton traveled, as it seems to have arrived in the San Juan area without the other agricultural items which accompanied it in the Hohokam (assuming it to have come from there). He solves this himself saying one pumpkin possesses little advantage over any other, while cotton is a definitely superior product to other available vegetable fibers, e.g., apocynum.

Let us then begin the problem of the origin and diffusion routes of cotton in the Southwest with a proposition of a definite scheme. Following Gladwin (1957:86) we shall take the Hohokam from the central western coast of Mexico, up along the western coast to the Colorado River and thence to the Gila River to the Salt and Verde and Santa Cruz rivers, branching out over the south central area of Arizona. If we allow this, and allow the Hohokam to bring the cotton with them, we have cotton in the Southwest. And getting the cotton spread out from the Gila, Salt and Verde region to the rest of the southwest is no problem, as it could have been done in as little as one year under ideal conditons. Gladwin (1957:126-7) then proposes migration and trade routes between Anasazi and Hohokam, primarily north on the Verde River, east just south of the San Francisco mountains and north again to the Hopi country south of Black Mesa, and on north to the San Juan drainage. Ccarter (1945:83) supports this scheme, suggesting a movement from Hohokam to Hopi to Pueblo. From this point the route providing cotton to Chaco Canyon and adjacent areas. This route, in the main, follows natural paths one might expect, i.e., along waterways and avoids high ranges of mountains as much as possible, starting from, say, Snaketown.

Another cotton transportation route which has been suggested is up the Rio Grand to Mogollon and spreading from there. There are several faults in this scheme, not the least of which is the scarcity of cotton finds in sites along this route, and in several cases this is not just due to a preservation factor. On the plus side, the earliest historic accounts admit of cotton along the Rio Grande in Texas. Joe Ben Wheat (1955:153) grants cotton to Mogollon in early San Francisco, which for him is about 600 AD and Gladwin (1957:26) credits cotton to the cave dwellers of the Upper Gila at about 200 AD. Neither give references, nor good locations of the sites in question, not even names, and neither ascribes cultivation explicitly, and these samples may have come in from the south in the finished form. For these reasons I have maintained the former route.

Let us then begin citing reports of cotton occurrence in the Southwest with Hohokam site of Snaketown on the lower Gila River, near Phoenix, Arizona, and spread out from there. This is near the center of the Hohokam area as of about 800 AD.

Sayles, in Excavations at Snaketown (1938:162) reports finding cotton textiles in the Sacation phase of Snaketown, which he equates chronologically with P. II at Flagstaff. This seems to me to be some what late since the estimated date on the canal that is earliest known is 800 AD (Gladwin 1957:147). This may be a preservation and/or dating problem. Then too, this may represent the first period in which sufficient textiles remained behind to guarantee preservation. A negative report establishes only that the item in question was not found. Again, concerning the canal, it has been pointed out that the remains of earlier canals might have been destroyed in reconstructing the canal works due to silting problems. The date given , therefore could be very much too late to reflect the beginning of irrigation, which in turn would reflect the earliest possible date of cotton agriculture. And last it should be noted that by the end of Colonial period, Hohokam had 167 known sites ranging from the junction of the Verde and East Verde rivers in the north to within about seventy-five miles of the Mexican border on the south and from the San Pedro River in the east to west of the Big Bend reservation, on the Gila River, to the west. I feel this must signify some considerable economic florescence of the type offered by extensive agriculture.

In conjunction with Snaketown, Grewe site (sacaton 9:4) reported by Woodward in 1931 and referred to by McGregor (1941:155) offered up a bowl of cotton seed, which by accepted standards is pretty convincing proof of cotton agriculture. This site is also Colonial Hohokam and considered by McGregor to be the earliest evidence of cotton cultivation in the Southwest.

The earliest record of the Yuma raising cotton is historic, recorded by the Spanish invaders from Mexico who related that the Yuma had the cotton itself but did not or could not process it, and as a result wore Moqui or Opa goods. According to Castetter and Bell (1951:115-120) they utilized maricopa themselves. Apparently they did not benefit too much from the Hohokam in spite of their comparative closeness. I could find no record of any tribe west of the Hohokam raising cotton that far south.

To the south of the Snaketown area is Casa Grande, which is apparently fairly late, 11-1200 AD (Gladwin 1957:267) and is at best Sedentary as is signified by appearance of copper bells. Of Casa Grande, Fewkes (1907:147) relates, "From a number of fragments of cloth excavated at Casa Grande there is little doubt that the prehistoric inhabitants of this settlement were familiar with native cotton and had also fabrics made of other vegetable fibers."

Due south of Snaketown about one hundred miles lies Ventana Cave which in later levels yields some cotton textiles. Haury (1950:168) says, however, it would "appear that most of the cotton in Ventana Cave came from some distance, probably the Gila Valley, and possibly already made up as cloth." But on the other hand "We can, nevertheless, be reasonably sure that the Papago did grow it in earlier times." The dates on the levels from which this cotton was recovered were from 800 AD to 1400 AD. Importation seems the more likely because of the absence of irrigation in the area; at least it was not mentioned.

According to Di Peso (1956:459) the Upper Pima from the area around Tumacacori were perhaps cultivating cotton as early as 950 AD to 1250 AD, with the intursion of Hohokam. Assuming the later date I would agree, but due to the apparent distribution of cotton in northern Mexico prior to 1750 as shown by Beals (1932:171) they might just as well have gotten it from the south.

Tuthill (1947:64) found an impression of a textile on a wall of pithouse 16 in Tres Alamos at the extreme southern Arizona section of the San Pedro River. He dated this house at 7-900 AD (Cascabel phase) but the construction resembles Mogollon three circles phase, not Hohokam and not Anasazi.
In any event he found no cotton.

In general it may be said that evidence of cotton and the cultivation of cotton gets thinner and thinner as one goes east, south, and west in Arizona. The evidence to the north is considerably greater.

In the Verde Valley, south of Flagstaff, is Montezuma's Castle, apparently a pueblo III site though Gladwin (1957:245) considers it some what earlier. According to Kent (2:5) there was quite a bit of textiles the most common material of which were cotton and meca. She gives no earliest date but says that sherds indicate a late date but says that sherds indicate a late date of about 1425 AD.

Also in the Verde Valley are the Red Rock ruins examined by Fewkes in 1895. He said of them concerning cotton, "Fabrics made of cotton are common in the ruins of the Red-rocks and at times this fiber was combined with yucca." He gave no date but I think early P. III would be a fair estimate.

It might be inserted here that Roberts (1935:517) feels that P.I, in general, had both cotton and the cultivation of cotton. I did not find any site in this survey in which it was definitely shown that there was cotton in a P. I period of Pueblo, though admittedly I did not find all the site reports, nor did I write the various museums in the country to discover what they had that we had not in the library. Volney Jones (1936:55) cites Kidder and Guernsey to this effect from their Kayenta work. However, as noted earlier, their work included artifacts in P. I which have since been dated later.

McGregor (1951:129) states that much evidence was found of the fine over-under weave in the Cohonina area, northwest of Flagstaff, with an approximate date of 1070 AD. This might well have been cotton, due to the fineness of the weave and the closeness to areas to strongly suspected of cotton cultivation. No bolls or textiles or seed were found however.

Whiting (1939:8) ascribes cotton to the Hopi prior to 1276 AD which fits very well with Guernsey (1931:97) who found cotton in Tsegi Canyon ruins in the Kayenta area (northwest section) and which he dated at P. I. This site is probably a P. I. site by today's standard, as the Pecos conference had long since been held. However, in 1921, Guernsey and Kidder, again working in the Kayenta region of Arizona did not find cotton in what they labeled a,B.M. III site, though the site held (among other things) a hard cradle. There was weaving only with apocynum. Then again Kidder and Guernsey (1919:115) found the afore mentioned cotton at the Marsh Pass Ruins. They found cotton everywhere including B.M. sites, but mixed in with all this were artifacts dating the various ruins as up to P. III, so that the total time range may be indicated, but no more specific date may be derived. Apparently the dwellings were more or less continously occupied for about eight hundred years.

Judd (1926:148) found cotton in the cliff dwellings of Cottonwood Canyon near Kanab, Utah, which also contained a number of Pueblo periods, in the artifacts. Cliff dwellings are, according to Martin, Quimby, and Collier (1947:129) a P. III characteristic which would put cotton that far west at an early date of about 1100 AD to 1200 AD, I would not be surprised if later work pushes that date back a little.

Moving north and east from the Black Mesa area into southern Colorado at Mesa Verde, O'Bryan (1950:81-2) reports no cotton in his excavations but some was found in near by caves, and thereby assumes that there was probably cotton at Mesa Verde. The scarcity may also be due to the high altitude as the limit for growing G. hopi is 5800 feet, as reported by Judd (1954:71). The altitude of two marked points in the area are about 6200 feet and 7000 feet.

To the south, in Chaco Canyon, Hewett (1936:111) reports cotton but says it was probably obtained from the Rio Grande valley. "Though it...was the principal material used in weaving cloth." He quotes Hawley's dissertation on the dendrochronology of Chaco Canyon as being 816 AD to 1127 AD for the canyon in general.

Pueblo Bonito as described by Judd (1954:69) is credited with cotton cloth but he feels, unlike Hewett, that it was Hopi cotton and may have come "ready to wear." Where ever they got it, they apparently did not raise it for themselves. The date on Pueblo Bonito, again according to Hawley's dissertation, is 919 to 1127 AD.

Considerably to the east of Chaco Canyon lie the Jemez Pueblo and Jemez Cave. Jemez Cave, reported by Alexander and Reiter (1935:53) was free of cotton despite its late estimated date of 1250 to 1300 AD, and despite it's showing much influence of the San Juan area. This could be a preservation factor. The Jemez Pueblo is a very late site reported by Reiter (1938:181). Here he found much cotton textile, both coarse and fine, and in addition, seeds. This site was at its peak between 1575 and 1627 AD (estimated) with an historically known flourishing occupation at 1605 AD.

Three locations around Sante Fe, New Mexico, are the Pajarito Plateau, north of Sante Fe: the Pecos area, southeast of Sante Fe, and Pindi (Tewa) area southwest of Sante Fe. Of Pajarito, Hewett and Dutton (1953:121) say that cotton was the principal material used in weaving but that it came from the Rio Grande valley. This general area was occupied between 1100 AD and 1600 AD.: no further pin-pointing was done. Kidder (1936:301) recovered three pieces of cotton from his Pecos site, but does not credit the Pecos with cultivation. The date estimated was 1250 AD, and referred to the local climax. Stubbs and Stallings (1953:69) reporting on Pindi Pueblo, state that there was found no cotton at an estimated date of 1300 AD, but reported some yucca fibrous materials. Apparently cotton had not made firm inroads here. I doubt that cotton is much less durable than yucca.

This seems to be the southern limit of cotton on the Rio Grande in New Mexico, though Beals (1932:171) reports early cotton on the Rio Grande in Texas, apparently as a northward extension of Mexican cotton; whether or not this can at some future date be tied in with Mogollon is a matter of conjecture.

Finally, for the purpose of this paper, we have the south eastern area of New Mexico, occupied by the Mogollon. Of this area in general, Carter (1945:81) says "Since Mimbres is the final period in the Mogollon culture, the scarity of cotton argues against their earlier possession of this crop and against their derivation from Mexico." This agrees with Beals (1932:135) in so far as generalities are concerned but may still have occurred. Jones (1936:55) does not even mention the area except to say that the rare cotton finds are considered intrusive.

On the other side, and apparently with more recent data, are Joe Ben Wheat who, as noted earlier, cited cotton in early San Francisco phase of Mogollon, without giving references however, Gladwin (1957:26) who credits the cave dwellers of the upper Gila river with cotton at 200 AD also without references. Perhaps Wheat refers to Martin (1952:483) who cites cotton cloth in Mogollon during San Francisco phase at Tularosa Cave. This is quite early but he makes no reference to seeds, or bolls, and so leaves considerable doubt as to cultivation, in spite of what Carter (1945:80) says is a superior area for cultivation (for the Southwest). It might be added that Haury (1936:129) found no evidence of cotton at the Harris site which encompassed Three Circles, Georgetown, and San Francisco phases of Mogollon. Certainly Mogollon provides the most scanty evidence of cotton of the three areas discussed.

The Hohokam may well have borrowed cotton from Anasazi, but according to Gladwin they were a conservative people and reluctant to borrow anything. The origin of Hohokam is still in doubt, at least to Gladwin, hence any migration from Mexico is purely hypothetical. At least Beals demonstrates a distribution of cotton along the west coast of Mexico which could possibly lead to cotton in the Southwest. Eastern Mexico was inhabited by nomads primarily (Beals 1932:135) so that a New Mexican or eastern Arizona entry for cotton seems even more unlikely.

In Beals 1932 paper on Northern Mexico, he postulated a southern origin for Southwest culture, based on a trait list of one hundred and four items which occur in Mexico; fifty-eight occur in the Southwest. This is obviously too much similarity to be attributed to chance. Gladwin and Gladwin (1935: 268-9) postulate a flow of traits from Mexico through Hohokam and Mogollon to Anasazi. With special reference to the Southwest they note (Ibid.:270) that Hohokam redware is found in some B. M. III sites demonstrating an established route. Due to a lack of B. M. III items in Hohokam sites it is apparently pretty much a one way flow. This has implications regarding cotton distribution in the Southwest. It is also noticeable that except for the Black Mesa area of Arizona the earliest dates for the appearance of cotton are later than the dates for Colonial Hohokam.

At the present state of knowledge there is nothing directly contradictory to the hypothesis, but I would consider any tendency to regard the evidence as conclusive naive. At best, the evidence only leans in that direction.

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